ELECTRIC DRIVE UNIT

Prior Art

The invention is based on an electric drive unit as generically defined by the preamble to claim 1.

From German patent disclosure DE 32 35 622 A1 and US Patent 4,572,979, a design of an electric drive unit is known. Among other elements, it comprises an electric motor with a stator and a magnet in a pole housing, a rotor with an armature, and a gear in a gear housing. The pole housing and gear housing are joined together, making for a high number of parts to be assembled and high production costs.

The gear housing is made from plastic.

In the prior art, the motor housing either has a short-circuit element or is a pole housing that takes the form of a cup of a magnetically conductive material and thus acts as a short-circuit element. In both cases, two magnetic half shells are mounted on the inside in the housing. They are partly fixed by retention springs in the pole housing and/or, because of the incident vibration and also to reduce noise, they are adhesively bonded between the magnet and the pole housing.

The pole pot bottom contains a cylindrical or domelike bearing, which acts as a radial bearing for supporting the rotor.

After their manufacture, these parts, comprising an electric motor, magnet and bearing, exist in the form of separate components or a component group that have to be connected to the gear housing by screws or wedging.

Often, to reduce the longitudinal armature play, a spacer is also mounted between a face end of the rotor and a bearing in the pole housing, in order to compensate for tolerances of the rotor and pole housing.

From German patent disclosure DE 43 20 005 A1 and US Patent 5,895,207, it is already known to make the pole housing of an electric drive unit of plastic and for the magnets to be retained in the plastic. However, the gear housing and the pole housing are screwed together.

From German patent disclosure DE 197 24 920 A1, it is already known to accommodate a motor and a substantial portion of the gear in one housing, in which the motor is also located. A separate gear housing is always still necessary, however. Furthermore, this reference provides no information about how the motor is accommodated in the housing or what material comprises the housing.

Advantages of the Invention

The electric drive unit of the invention having the characteristics of the body of claim 1 has the advantage over the prior art that in a simple way, the number of parts to be assembled and the production cost are reduced.

By the provisions recited under dependent claims, advantages refinements of and improvements to the electric drive unit recited in claim 1 are possible.

The use of plastic for the housing is advantageous, because in this way, watertight pole and gear housings can be produced, and the weight of the drive unit can be reduced.

It is especially advantageous for magnets and/or a short-circuit element and/or an armature bearing to be injected into the pole housing, since this reduces the production cost and the number of parts to be assembled.

The use of a one-piece short-circuit element has advantages because it reduces the number of parts to be assembled.

It is also advantageous in the event of corrosion problems to spray-coat the short-circuit element with plastic on the outside.

By positive and nonpositive engagement, the at least one magnet or the short-circuit element can advantageously be secured in the pole housing, so that no further securing elements are necessary.

It is advantageous to keep the longitudinal armature play very slight by the insertion of an end shield with the motor bearing after a shaft has been installed.

Drawing

Exemplary embodiments of the invention are shown in simplified form in the drawing and described in further detail below.

Fig. 1 shows a first exemplary embodiment of a drive unit embodied according to the invention;

Figs. 2a-e show various possible ways of integrating the at least one magnet and the short-circuit element into the pole housing.

Description of the Exemplary Embodiments

Fig. 1 shows a first exemplary embodiment of an electric drive unit 1 according to the invention. The electric drive unit 1 comprises a gear housing 5 and a pole housing 10. The gear housing 5 merges without any additional connection with

the pole housing 10, and the gear housing 5 can also be in multiple parts. For instance, a cap, not shown, and a bottom 6 can form the gear housing 5. The installation of a gear and optionally the installation of a bearing in the gear housing 5 is thus made possible because the cap is mounted later. The bottom 6 of the gear housing 5 in this example is in one piece with the pole housing 10. The gear housing 5 and the pole housing 10 can be of plastic or metal. If a housing 5, 10 is of plastic, then it is produced for instance by plastic injection or plastic casting. A plastic pole housing 10 of plastic can also be injection-molded onto a metal gear housing 5, so that any combination of materials is possible for the housings 5, 10. A worm drive 7, for instance, with a gear 8 not otherwise shown is located in the gear housing 5.

An electric motor 15 is located in the pole housing 10. The electric motor 15 comprises a stator 18 and a rotor 20. The rotor 20 is formed of an armature 22, a commutator 25, and a shaft 28. The shaft 28 has an axial longitudinal axis 30.

The stator 18 comprises two magnets 32.1, 32.2, for instance, and a short-circuit element 36. The magnet 32 can be in one piece or can comprise multiple parts 32.1, 32.2.

The short-circuit element 36 can comprise two steel half-shells, for instance, or be in one piece, for instance comprising a steel ring, and can thus form the magnetic short

circuit for the magnets 32. The short-circuit element 36 can be made from any magnetically conductive material.

This may also be a mixture of plastic and a magnetically conductive material that is injected into the pole housing 10.

The at least one magnet 32 and the short-circuit element 36 are integrated with the pole housing 10.

The shaft 28 is supported at least two points. On an end 40 of the shaft 28 toward the motor, an end shield 43 with a motor bearing 45 is present which initially is still axially adjustable. The end shield 43 and the motor bearing 45 can be embodied in one piece and can for instance be of plastic. The end shield 43 can also comprise a metal motor bearing 45 spring-coated with plastic. One indentation 44, for example, is provided in the pole housing 10, and the end shield 43 can be introduced into this indentation.

Downstream of the electric motor 15, viewed in the direction of the gear housing, and in this case downstream of the commutator 25, for example, there is an armature bearing 48 which is injected for instance into the pole housing 10. A further bearing, a so-called gear bearing 50, is located on an end 53, toward the gear, of the shaft 28 in the gear housing 5. The end 53 toward the gear and the end 40 toward the motor of the shaft 28 are shaped as a run-up cup 55, for instance.

In the production of the electric drive unit 1, magnets 32 and short-circuit elements 36, for instance, are placed in an injection molding tool and then, by injection of plasticized plastic into the injection-molding tool, the bottom 6 of the gear housing 5 and the pole housing 10 are formed.

After the assembly of the rotor 20, gear 8, and so forth, the end shield 43 with the motor bearing 45 is inserted into the pole housing 10 axially in such a way that the longitudinal armature play is minimal. Shims to compensate for tolerances of the shaft and housings are unnecessary.

The end shield 43 can for instance be screwed into a thread 57 present in the pole housing 10, or glued by a worm of adhesive, or joined to the pole housing 10 by ultrasonic welding or lasers. All this produces a watertight connection.

Given a suitable choice of material for the bearing plate 43, the motor bearing 45 can not only perform radial support but can also absorb the axial run-up forces of the rotor 20. Furthermore, the end shield 43 with the motor bearing 45 can be pressed axially with slight prestressing force against a steel run-up cup 55 of the shaft 28 and be fixed to the pole housing 10 in an axially play-free state of the shaft 28.

recesses 72, for instance of stepped design, into which the magnet 32 and the short-circuit element 36 are inserted, located one above the other and secured. The plastic of the pole housing 10 surrounds the magnet 32 and the short-circuit element 36 completely toward the rotor 20. This increases a minimal spacing between the armature 20 and the magnet 32.

In Figs. 2a, b, c and e, the short-circuit element 36 is exposed on the outside, for the sake of better heat radiation. If corrosion has to be avoided, then this is done either by a suitable choice of material, or as in Fig. 2d, by spray-coating the outside of the short-circuit element 36.

To achieve a good, tight binding of the short-circuit element or short-circuit elements 36 to the pole housing 10, an appropriate peripheral region of the short-circuit elements 36 can be embodied in perforated or ribbed fashion, for instance. Vibration between the magnet 32 and the short-circuit element 36 cannot occur, since both the magnet 32 and/or the short-circuit element 36 are injected firmly into the pole housing or secured firmly in it.

In general, the described design is suitable for achieving watertight electric drive units, because the already tight plastic gear housing can also be welded in watertight fashion toward the gear to a plastic cap.